Marketplace: Tower Technology
Windpower
October 2009

Developers tell tales of lofty towers

Taller towers will help developers reap rewards at new heights, provided they can handle the logistical obstacles involved.

By Deston Nokes

As wind turbine generators increase in size, some tower manufacturers are gearing up to accommodate developer requests to rise above 100 meters in height.

One developer, WindKraft Nord, USA (WKN), has already led the way. In December 2007, it became the first company in North America to exceed 80-meter heights with its 63-megawatt Snyder Wind Project, located in Scurry County, Texas. Now owned by Enel North America, Inc., the project features 21 Vestas V90 3MW wind turbine generators sitting atop towers rising above 105 meters.

"No other developer has erected towers that tall in the Western Hemisphere," said Florian Zerhusen, president of WKN USA. "Our first 105–meter project was built in late 2004 in Germany; and we have built these taller towers in Italy, Spain and Poland," he says, adding that the company intends to build taller, Snyder-style projects.

Today, with so many of the "lower" level resources being harvested, companies are seeking ways to maximize domestic wind generation. WKN USA was the first in the U.S. to vault higher to take advantage of wind resources at higher altitudes. However, all signs indicate that more developments will include taller towers.

Why the sudden in interest in surpassing the 100-meter mark? According to a few developers and manufacturers, there were plenty of development opportunities at the 60- and 80-meter levels, so manufacturing was geared toward those heights. Spending the extra money on steel, labor and transportation wasn't deemed necessary.

"We have quoted several towers over 100 meters in height to various customers in the industry," said Jess Collins, group president at Broadwind Energy. "Some will be built next year. It will likely be a low quantity to start, but I think everyone's thinking the same thing and that most manufacturers will be moving that direction."

"It's the natural progression of the industry, since larger generators and rotors will require larger towers" explained Don Bain, principal at Aeropower Services, Inc., who has worked in the wind industry since 1975. "Going above 100 meters has substantial advantages. Developers can then use sites that formerly were not deemed windy enough. It's a matter of picking the low-hanging fruit and then moving higher up."

Peder Hansen, executive vice president of Northstar Wind Towers in Nebraska, knows about

scaling heights. He grew up in Lem, Denmark, where his grandfather, also named Peder, and his father, Finn, worked at Vestas. His great grandfather started the firm in 1898.

“I believe the industry will become more focused on tower heights, at least as much as it is on turbine and blade development,” he said. “Turbines and rotors will continue to get bigger, so the question arises, how do we make the towers more efficient?”

Hansen said that taller towers take advantage of wind shear, or wind gradient. “In general there are higher wind speeds as you increase altitude. One can measure the increase in the wind speed and the decrease in turbulence as they move above the boundary layer close to the ground. This effect is especially pronounced in the Midwestern part of the United States.”

As with any wind project, having accurate data is critical. “Having the proper sheer factor is very important,” Zerhusen. “That’s where the work comes in. If the cost of manufacturing and installation increases, how quickly can the additional investment be recouped? Because we have that experience and hard data available, that’s how we are separating ourselves.”

Installing turbines on taller towers, Hansen says, increases the potential power output from a wind turbine. “The difference in wind speed from 80 to 100 meters is roughly 8 percent, which results in a typical 15 percent energy increase; this without any additional turbine grid interconnection cost.”

“It’s worth a lot of money to get those turbines spinning at a constant rate,” he said.

The cost of redesign

“You do incur greater costs in manufacturing, transportation and construction when you go higher,” Zerhusen observes. “The manufacturing infrastructure already exists for towers at 60 and 80 meters. But to reach 105 meters, we had to redesign because certain equipment was not commercially available.”

Welding and hoisting 105-meter towers also requires having more equipment onsite, Zerhusen said. “For example, there are few cranes that can accommodate these weights and heights, which we found though our subcontractor, Barnhart Crane. Hauling the crane itself required about 60 truckloads of equipment, including the huge counterweights to lift the turbine up to the required height.”

Despite the challenges, Zerhusen said that having a strict construction schedule was the key. “We did the Snyder project on budget and on time,” he said.

Broadwind plans to build taller towers through its subsidiary, Tower Tech Systems, and will haul tower sections and other wind components through its heavy-haul subsidiary, Badger Transport.

“We’ve already made the shift in our manufacturing capabilities,” Collins said. “Tower Tech is strategically positioned to build these new generation towers, which are heavier and thicker.”

“Our facilities are located in strong wind markets and have been outfitted with the heavier equipment to bend, weld and lift these heavier and thicker structures,” Collins said. “We have two facilities outfitted and designed to produce the larger towers, and our third facility under construction also have the capability.”

Collins agreed that acquiring the right crane is a factor, but that’s more of a transportation issue.

“We haul it all – from the tower components, turbines and blades,” he said. Broadwind invested in new generation, heavy-haul equipment for Badger Transport. “Just like towers, there are size implications with the blades, turbines and other components as we go to larger designs.”

Collins said that 60 and 80-meter towers are manufactured in three or four sections. Moving to a 100-meter design will mean five sections, which will help in transporting them to the site.

“The challenges of hauling the new towers are obvious,” he said. “Most 80-meter towers already are 14 feet in diameter at the base, and increasing it will be an even bigger challenge when it comes to bridge clearance. A larger-diameter structure means a taller load once it becomes horizontal on a truck. Finding routes through many states already is a challenge, and it will continue to get tougher. “

Collins notes that trains have been helpful in transporting components to wind sites, but any increase in tower diameter will limit rail’s ability to serve the wind industry.

As turbines and rotor diameters grow, the physical demands on the towers will continue to increase.

“To build 105-meter towers, the foundation, has to be redesigned larger,” Zerhusen said. “Plus it also depends on the soil condition.”

According to Hansen, there are two options for managing the loads of these massive turbines: The first is to increase the structure’s wall thickness, and the second is to increase the bottom diameter of the tower, thus enabling a continuous or increasing taper towards the foundation.

“Thicker walls are the number-one option today because transportation restrictions dictate the maximum diameter allowed,” Hansen says.

Northstar has designed a tower with flared, lower sections that would be transported in pieces and assembled in the field. “With this design, tower panels can be added to increase the tower diameter and height,” Hansen explained. “The increased base diameter allows for thinner tower wall thicknesses – resulting in a more efficient use of steel.”

According to Hansen, Northstar’s segmented flanges at the tower top and base allow for conventional attachment with the turbine and foundation. The bottom flange is modeled using the same mounting criteria as used on conventional towers. The bottom diameter however, creates new options for the foundation design. Hansen said it is now possible to make foundations wider, resulting in less depth. This, he says, eliminates the need for costly embedment rings that are used within the foundation to distribute the load from the turbine.

While many developers are looking offshore and overseas for new wind resources, these developers are placing their efforts into reaching higher at existing locations.

“Although off-shore wind has a lot of potential long term, there are still many land-based opportunities for wind in North America,” Collins says. “A lot depends on the financial markets and transmission dynamics as we move forward.”

Deston Nokes is a freelance writer based in Portland, Ore., who specializes in energy and environmental issues. He can be reached at deston@destonnokes.com.